



2003 AFCEE Technology Transfer Workshop

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Promoting Readiness through Environmental Stewardship

Honeybees for Detection of Chemical Explosives and Environmental Contaminants

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Air Force Real Property Agency



Performers

Mr. Don Ficklen

- **Org: AFCEE**
- **Role: Air Force Liaison for Project Management and Technology Transfer**

Dr. Alan Rudolph

- **Org: Defense Advanced Research Projects Agency (DARPA)**
- **Role: Technology Sponsor**

Mitretek Systems, Inc.

- **Role: Technical Support**

Dr. Bob Cartledge

- **Role: Technical Support**

Dr. Jerry Bromenshenk

- **Org: University of Montana**
- **Role: Primary Researcher and Field Expert**

USAF Force Protection Battlelab

- **Role:**



DISCUSSION TOPICS

- What Do We Know About Bees?
- Applications
- Bee Research History
- Air Force Needs
- Goals and Objectives
- Demonstration Plan
- Technology Transfer Strategy
- Benefits and Issues



What do we know about bees?

- Bees passively collect environmental information (absorbed or ingested) while flying or by contacting dusty surfaces and gathering specific contaminants in plant nectar, pollen, resins, water
- Bees can be trained to be sensitive detectors or chemicals (explosives, drugs) and are at least as good as dogs in smelling odors
- Bees can find targets in the field and be tracked using electronic devices
- Bee hives can be instrumented to detect what bees bring back



Applications

- Chemical collection and detection
 - Explosives
 - RDX, HMX, TNT
 - Environmental contaminants
 - VOCs, SVOCs, heavy metals, pesticides, PCBs
 - Illegal drugs
- Biologics
 - Spores, viral agents, pest and parasites
- Security and homeland defense
 - Concealed targets, crowd control, search and rescue



Bee Research History

- In 1974, the University of Montana (UM) initiated research using honey bees for biomonitoring experiments
- In 1978, EPA sponsored a pilot investigation of the feasibility of using honey bees for monitoring environmental contamination
- In 1982, the Pacific Northwest Laboratories joined UM and EPA in another research project using honey bees to determine exposure levels, identify sources and map the distribution of trace elements and radionuclides
- During 1995-2000, demonstration of honey bee biomonitoring technology was conducted at Aberdeen proving ground, MD to access toxic chemical contaminants in military-unique, terrestrial ecosystems



Air Force Needs

- AF needs
 - Pre-planning for environmental process
 - Help to allocate AFCEE resources and set priorities
 - Detection of unexploded bombs on weapons ranges
 - Field application verification of technology for use in environmental investigations and monitoring
 - Implementation of field pilot test
 - Analytical confirmation of bee contaminant detections
 - Implementation of full-scale demonstration project
 - Attain EPA and public buy-in for this technology



Goals and Objectives

- **Goals**
 - Determine utility as low-cost capability for wide area sampling
 - Site Characterization, LTO, LTM, Weapons Ranges
 - Determine capability to locate hot spots
 - Unexploded bombs or contaminant sources
 - Gain EPA acceptance for use in cleanup process
- **Objectives**
 - Correlate contaminant concentrations in honeybees with concentrations in soil and water
 - Prepare protocol acceptable to EPA
 - Answer deployment questions
 - How many hives? How long /when to monitor? Where to locate?



Demonstration Plan

- Field Tests to Evaluate Usability
 - Correlate honeybee and actual site concentrations
 - Volatile organic compounds and metals
- Wide-area screening at ranges and other large AF sites
 - Perform site characterization
 - Detect hot spots
 - Energetic Compounds and Location of UXO
- Develop EPA technology demonstration report/protocol
- Include this technology as part of the AFCEE “tool box” of innovative technologies
- Partner with other DoD agencies to continue evaluating bee technology on other environmental investigation/monitoring projects



Technology Transfer Strategy

- Phase I: Field tests to evaluate usability
 - Continued AFCEE and support contractor involvement in assisting application of this technology at a selected field demonstration site
 - Develop and submit honeybee application strategy plan to DARPA for their review and approval
 - AFCEE will request additional funding from DARPA to initiate field demonstration
 - Conduct Phase I field demonstration at a range operated by the Montana National Guard
 - DARPA will subcontract the University of Montana to provide technical oversight
- Phase II: Full scale site characterization with regulatory oversight and participation
 - Develop a funding/partnering strategy with involved agencies (DARPA, AF, EPA, SERDP, ESTCP, etc.) to provide funding, technical assistance and a site for full scale demonstration project



Technology Transfer Strategy

- Conduct full-scale characterization at selected range site
 - Verify honeybee contaminant concentrations obtained at a known UXO impacted demonstration site with rigid QA/QC analytical methods and protocols
 - Conduct a second demonstration over a large unknown area to screen for localized “hot spots”
 - Verify honeybee “hot spot” detection areas with laboratory analysis
- Phase III: Development of EPA, Tri-Service and Interstate Technology Regulatory Council (ITRC) protocol
 - Add this technology to AFCEE’s “tool box” of innovative technologies
 - Work with SERDP, ESTCP, RPMs, Team Chiefs to implement technology at other installations



Benefits and Issues

- Benefits
 - AF gains low-cost, environmental assessment capability acceptable for wide area sampling
 - No such capability exists now
 - Reduced costs for site characterization and LTM
 - Technology transfer to other DoD agencies and industry
 - EPA buy-in and technology acceptance
 - Develop tool for military applications for UXO detection and homeland defense
- Issues
 - Usability of chemical information for decision making
 - Technology acceptance and implementation
 - Management and regulatory buy-in
 - Reduced innovative technology budgets